

WHAT IS CLAIMED IS:

1 A process of dyeing poly(m-phenyleneisophthalamide) fabric comprising:

- (a) dyeing the fabric at a temperature in the range of about 100°C to about 150°C and elevated pressure in a fiber-dyeing solution containing a tinctorial amount of at least one dye and a dye diffusion promoting amount of an <sup>aromatic</sup> amide having 7 to 14 carbon atoms capable of increasing the swelling <sup>value</sup> ratio of the fabric, ~~as defined herein, at least 1.5% and excluding~~  
~~N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones,~~  
then
- (b) heating the fabric while in contact with the solution until the desired degree of dyeing is attained.

2. The process of claim 1 in which the dye is an acid, direct or disperse dye.

3. The process of claim 1, in which the amount of dye diffusion promoting agent is from about 10 to 120 percent by weight of fabric.

4. The process of claim 1, in which the ratio of dyeing solution to fabric is from about 40:1 to about 4:1 by weight.

5. The process of claim 1, including the additional step of (3) removing any residual amide from the fabric.

6. The process of claim 1, in which the fabric is dyed at a temperature of about 130°C.

7. The process of claim 1, in which the fabric is dyed for about 15 minutes to about 2 hours.

8. The process of claim 1, in which the fabric is a blend of poly(m-phenyleneisophthalamide) and poly(p-phenyleneterephthalamide) fibers, and the dye is a basic dye.

9. A process of dyeing a blend of poly(m-phenyleneisophthalamide) and poly(p-phenyleneterephthalamide) fibers comprising:

- (a) treating the fibers at a temperature in the range of about 100°C to about 150°C and elevated pressure in a solution containing a tinctorial amount of a basic dye and a dye diffusion promoting amount of an <sup>aromatic</sup> amide having 7 to 14 carbon atoms capable of increasing the swelling <sup>value</sup> ratio of the fabric, ~~as defined herein~~, at least 1.5% ~~and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone~~, then
- (b) heating the fabric in the solution until the poly(m-phenyleneisophthalamide) fibers have been dyed and the poly(p-phenyleneterephthalamide) fibers have been stained.

10. The process of claim 9, in which the fabric is a blend of 0 to 10% by weight of poly(p-phenyleneterephthalamide) fibers, balance poly(m-phenyleneisophthalamide) fibers.

11. The process of claim 9, in which the fabric is treated at a temperature of about 130°C.

12. The process of claim 9, in which the fabric is treated for about 15 minutes to about 2 hours.

13. A process of flame-retardant treating poly(m-phenyleneisophthalamide) fabric comprising:

- (a) treating the fabric with flame retardant at a temperature in the range of about 100°C to about 150°C and elevated pressure in a fiber-treating solution containing a flame-retarding amount of at least one flame retardant and a flame retardant diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling <sup>value</sup> ratio of the fabric, ~~as defined herein, at least 1.5% and excluding~~ ~~N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone,~~ then
- (b) heating the fabric while in contact with the solution until the desired degree of flame retardant fixation is attained.

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14. A process of simultaneously dyeing and flame-retardant treating poly(m-phenyleneisophthalamide) fabric comprising:

- (a) dyeing and flame-retardant treating the fabric at a temperature in the range of about 100° to about 150°C and elevated pressure in a fiber-treating solution containing a tinctorial amount of at least one dye, a flame-retarding amount of at least one flame retardant and a flame retardant diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone, then

(b) heating the fabric while in contact with the solution until the desired degree of dyeing or flame resistance or both is attained.

15. The process of claim 13 or 14, in which the amount of diffusion promoting agent is from about 10 to about 120 percent by weight of fabric.

16. The process of claim 15, in which the ratio of treating solution to fabric is from about 40:1 to about 4:1.

17. The process of claim 13 or 14, including the additional step of (3) removing any residual amide from the fabric by scouring.

18. The process of claim 13 or claim 14, in which the fabric is treated in step (1) at a temperature of about 130°C.

19. The process of claim 13 or 14, in which the fabric is treated in step (1) for about 15 minutes to about 2 hours.

20. The process of claim 14, in which the fabric is a blend of poly(m-phenyleneisophthalamide) and poly(p-phenyleneterephthalamide).

21. A process of dyeing poly(m-phenyleneisophthalamide) fabric comprising:  
(a) dyeing the fabric at a temperature of from about 70°C to about 100°C at atmospheric pressure in an aqueous dyebath containing a tinctorial amount of at least one

dye and a dye diffusion promoting agent consisting of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone, then

- (b) heating the fabric while in contact with the treating solution until the desired degree of dyeing is attained.

22. The process of flame-retardant treating poly(m-phenyleneisophthalamide) fabric comprising:

- (a) flame-retardant treating the fabric at a temperature of about 70°C to about 100°C at atmospheric pressure in an aqueous bath containing a flame-retarding amount of at least one flame retardant and a diffusion promoting amount of at least one amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone, then
- (c) heating the fabric while in contact with the treating solution until the desired degree of flame retardant fixation is attained.

23. A process for simultaneously dyeing and flame-retardant treating poly(m-phenyleneisophthalamide) fabric comprising:

- (a) dyeing and flame-retardant treating the fabric at atmospheric pressure in an aqueous dyebath containing a tinctorial amount of at least one dye, a flame-retarding amount of at least one flame retardant and a diffusion-promoting amount of an amide having 7

to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone, then

- (b) heating the fabric while in contact with the treating solution until the desired degree of dyeing or flame resistance or both is attained.

24. The process of claim 21, 22 or 23, in which the amount of diffusion promoting agent is from about 10 to about 120 percent by weight of fabric.

25. The process of claim 24, in which the ratio of treating solution to fabric is from about 40:1 to about 4:1 by weight.

26. The process of claim 21, 22 or 23, including the additional step of (c) removing any residual amide from the fabric by scouring.

27. The process of claim 21, 22 or 23, in which the fabric is treated in step (a) at a temperature in the range of about 70°C to about 98°C.

28. The process of claim 27, in which the fabric is treated in step (a) for about 15 minutes to about 2 hours.

29. The process of claim 21, 22 or 23, in which the fabric is a blend of poly(m-phenyleneisophthalamide) and poly(p-phenyleneterephthalamide) fibers.

30. A process of dyeing poly(m-phenyleneisophthalamide) fabric comprising:

- (a) applying to a poly(m-phenyleneisophthalamide textile fabric a solution containing a tinctorial amount of at least one dye and a dye- and/or flame-retardant diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone, then
- (b) heating the fabric while in contact with the solution until the desired degree of dyeing is attained.

31. A process of flame-retardant treating poly(m-phenyleneisophthalamide) fabric comprising:

- (a) applying to the textile fabric a flame-retardant diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone,
- (b) flame-retardant treating the fabric at a temperature in the range of about 100°C to about 150°C and elevated pressure in a fiber-treating solution containing a flame-retarding amount of at least one flame retardant, then,
- (c) heating the fabric while in contact with the solution until the desired degree of flame-retardant fixation is attained.

32. A process of flame-retardant treating and dyeing poly(m-phenyleneisophthalamide) fabric comprising:

- (a) flame-retardant treating the fabric in a solution containing a flame-retarding amount of at least one flame retardant and a diffusion-promoting amount of an amide

having 7 to 4 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidone,

- (b) dyeing the fabric of step (a) at a temperature in the range of about 100°C to about 150°C at elevated pressure in a solution containing a tinctorial amount of at least one dye, then
- (c) heating the fabric while in contact with the solution until the desired degree of dyeing or flame resistance or both is attained.

33. A dyebath for dyeing poly(m-phenyleneisophthalamide) textile fabrics consisting essentially of:  
a tinctorial amount of at least one dye; and  
a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5%.

34. A dyeing assistant which on dilution with water provides a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5%, and which with the addition of a tinctorial amount of at least one dye provides a dyebath suitable for dyeing poly(m-phenyleneisophthalamide) textile fabrics.

35. A dyebath for simultaneously dyeing and flame retarding poly(m-phenyleneisophthalamide) textile fabrics consisting essentially of:  
a tinctorial amount of at least one dye;



a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein at least 1.5%; and

0.05% to 5%, based on the weight of the dyebath, flame retardant.

36. A dyeing and flame retarding assistant which on dilution with water provides a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5%; and

a concentration of a neutral chloroalkyl diphosphate ester flame retardant of 0.05% to 5%, and which with the addition of at least one dye provides a dyebath suitable for simultaneously dyeing and flame retarding poly(m-phenyleneisophthalamide) textile fabrics.

37. A poly(m-phenyleneisophthalamide) textile fabric, or yarn containing within the fibers a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio of the fabric, as defined herein, at least 1.5%.

38. A process of dyeing a poly(m-phenyleneisophthalamide) textile fabric comprising the successive steps of:

- (a) supplying a poly(m-phenyleneisophthalamide) textile fabric having thereon a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio, as defined herein, at

least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones, then

- (b) applying a tinctorial amount of at least one dyestuff to the fabric and then
- (c) drying, then steaming the thus-treated fabric with saturated steam or superheated steam at an elevated temperature of at least about 100°C for a time sufficient to permeate and fix the dyestuff inside the poly(m-phenyleneisophthalamide) fibers.

39. The process of claim 38, in which the fabric of step (a) contains from about 10 to 120% by weight of the amide.

40. The process of claim 38, in which, prior to step (a), an aqueous bath containing the amide is applied to the fabric.

41. The process of claim 38, including the additional step of (d) removing residual amide remaining on the fabric.

42. The process of claim 38, in which the fabric is composed of poly (m-phenylenenisophthalamide) blended with up to 50% of other fibers.

43. The process of claim 42, in which the fibers blended with the poly(m-phenyleneisophthalamide) are at least one of poly(p-phenyleneterephthalamide), polybenzimidazole, flame-resistant cotton, flame-resistant rayon, nylon, wool or modacrylic fibers.

44. Th process of claim 38, in which the fabric consists entirely of poly(m-phenyleneisophthalamide).

45. The process of claim 38, in which at least one of a flame retardant, an ultra-violet light absorber, an antistatic agent, or a water repellent is also applied to the fabric in step (b).

46. A process of printing a predetermined pattern on a poly(m-phenyleneisophthalamide) textile fabric comprising the successive steps of:

- (a) supplying a poly(m-phenyleneisophthalamide) textile fabric having thereon a dye diffusion promoting amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones, then
- (b) applying onto the fabric a print paste consisting essentially of a tinctorial amount of at least one dyestuff, a print paste thickening agent, and water, in a predetermined pattern; and then
- (c) drying, then steaming the thus-treated fabric with saturated steam or superheated steam at an elevated temperature of at least about 100°C for a time sufficient to permeate and fix the dyestuff inside the poly(m-phenyleneisophthalamide) fibers.

47. The process of claim 46, in which the fabric of step (a) contains from about 10 to 120% by weight of the amide.

48. The process of claim 46, in which, prior to step (a), an aqueous bath containing the amide is applied to the fabric.

49. The process of claim 46, in which the fabric of step (a) has been dyed to a predetermined base shade using the amide as the dye diffusion promoter and also contains a flame retardant thereon.

50. The process of claim 46, including the additional step of (d) removing residual amide remaining on the fabric.

51. The process of claim 46, in which the fabric is composed of poly(m-phenyleneisophthalamide) blended with up to 50% of other fibers.

52. The process of claim 51, in which the fibers blended with the poly(m-phenyleneisophthalamide) are at least one of poly(p-phenyleneterephthalamide), polybenzimidazole, flame-resistant cotton, flame-resistant rayon, nylon, wool or modacrylic fibers.

53. The process of claim 46, in which the fabric consists entirely of poly(m-phenyleneisophthalamide).

54. The process of claim 46, in which the print paste additionally contains at least one of a flame retardant, an ultra-violet light absorber, an antistatic agent, or a water repellent.

55. A process of printing a predetermined pattern on a textile fabric composed of poly(m-phenyleneisophthalamide) comprising the steps of:

- (a) applying onto a poly(m-phenyleneisophthalamide)-containing fabric in a predetermined pattern a print paste consisting essentially of a dye diffusion promoting amount of an amide having 7 to 14 carbon

atoms capable of increasing the swelling ratio, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones, at least one dyestuff compatible with the amide, a print paste thickener compatible with the amide, and water and, thereafter,

- (b) drying and curing the thus treated fabric at an elevated temperature of about 100°C to about 210°C and for a time sufficient to permeate and fix the dyestuff inside the poly(m-phenyleneisophthalamide) fibers.

56. A print paste for printing and dyeing poly(m-phenyleneisophthalamide) textile fabric in a predetermined pattern, the print paste consisting essentially, in percent by weight, of:

about 10 to about 120 parts of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones to introduce a compatible dyestuff into the poly(m-phenyleneisophthalamide) fibers;

a tinctorial amount of at least one organic dyestuff soluble in an aqueous solution of the amide and capable of dyeing and fixing in the fibers:

a print paste thickener soluble in an aqueous solution of the amide and compatible with the other ingredients of the print paste, the thickener present in an amount sufficient to provide printing viscosity,

balance water.

57. The print paste of claim 56, in which the dyestuff is an acid, basic, mordant, direct, metalized disperse or reactive dye.

58. A process for pretreating poly(m-phenyleneisophthalamide) fibers or fabric comprising applying to said fiber or fabric a dye-enhancing or flame-retardant enhancing amount of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones.

59. The process of claim 58, in which the poly(m-phenyleneisophthalamide) fibers or fabric contain up to about 50% by weight of the amide.

60. The process of claim 58, in which the poly(m-phenyleneisophthalamide) fibers or fabric contain from 10% to 120% by weight of the amide.

61. Poly(m-phenyleneisophthalamide) fibers or fabric having from 10% to 120% by weight of an amide having 7 to 14 carbon atoms capable of increasing the swelling ratio, as defined herein, at least 1.5% and excluding N-octyl-2-pyrrolidone and N-cyclohexyl-2-pyrrolidones to make the fibers or fabric receptive to dyeing, printing or flame retardant treating.

62. The process of claim 55, in which step (b) is conducted in saturated steam at about 100°C.

63. The process of claim 46, in which setting of the print pattern is performed in superheated steam at a temperature of about 150°C to 210°C.

64. The print paste of claim 56, also containing at least one flame retardant.

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